

**ARIZONA GAME AND FISH DEPARTMENT
HABITAT PARTNERSHIP PROGRAM
HABITAT ENHANCEMENT AND WILDLIFE MANAGEMENT PROPOSAL**

PROJECT INFORMATION

Project Title: estimating the relative abundance of Sky Island black bears

Project No. 07-515

Region/GMU: Region 5, GMU's 34 A & B

HPC:

Project Type: population survey

Project Description: I propose to use non-invasive genetic sampling to estimate the relative abundance and extent of genetic and demographic connectivity of black bears in the Santa Rita and Whetstone mountains (combined area 680 km²) in the Coronado National Forest in southeast Arizona (Region 5, GMU's 34 A & B). Sky Island black bear populations have never been investigated, and the lack of statistically rigorous population estimates makes it difficult to (i) determine the harvestable surplus available to hunters, (ii) defend hunt recommendations to the public, (iii) defend lethal removal of "nuisance" bears, and (iv) determine the extent to which bears may be moving between Sky Island ranges- which affect all of the preceding points. By using non-invasive DNA sampling, I will be able to provide population and sex ratio estimates for bears inhabiting the Santa Rita and Whetstone mountains and quantify genetic and demographic connectivity (degree of genetic similarity and sex-specific dispersal) of bears inhabiting these ranges. Data collected from this work will compliment similar work done in summer 2007 in the Huachuca and Patagonia mountains (GMU's 35 A & B). If approved, this research will (i) provide reliable population and sex ratio estimates for black bears in GMU's 34 and 35, (ii) quantify the extent to which bears are moving between the Santa Rita, Whetstone, Huachuca, and Patagonia mountains, and (iii) identify possible movement corridors linking these mountains ranges.

Wildlife Species to Benefit: black bears

Possible Funding Partners: US Forest Service, Wilburforce Foundation, International Bear Association, Pope and Young Club, Bear Trust, World Wildlife Fund, Wildlife Conservation Fund

Implementation Schedule:

Beginning: 4/01/08

Completed: 8/15/08

NEPA Compliance: (if applicable)

Completed: Yes ___ No x

Projected Completion Date: 12/15/08

PROJECT FUNDING

SBG Funds Requested: \$14,000

Cost Share Funds: \$12,178 (from pending proposals and Research Branch)
Pending proposal match funds available after 1/1/08; Research Branch match funds available immediately (9/1/07).

Total Project Costs: \$26,178

PARTICIPANT INFORMATION

Applicant: Todd Atwood
(please print)
Telephone: (602) 789-3661

Address: Arizona Game and Fish Department, 2221
W. Greenway Rd. Phoenix, AZ 85023

AGFD Contact and Phone No. (If applicant is not AGFD personnel)	
Coordinated with: Gerry Perry, Region 5 Supervisor; Tom Skinner USFS Coronado National Forest	Date: 7/27/07
Applicant's signature:	Date: 8/30/07

SEND COMPLETED APPLICATIONS TO:

**Game Branch
2221 W. Greenway Rd.
Phoenix, AZ 85023
mdisney@azgfd.gov**

WAS PROJECT PRESENTED TO THE LOCAL HPC? YES _____ NO x

HAS PROJECT BEEN SUBMITTED IN PREVIOUS YEARS? No IF SO WAS IT FUNDED?

NEED STATEMENT/PROBLEM ANALYSIS:

This research will provide much needed information on the relative abundance, demographics, and genetic connectivity of black bears in the Santa Rita and Whetstone mountains. Additionally, this work will contribute to a greater endeavor, begun in 2007 in the Huachuca and Patagonia mountains, to quantify relative abundance and genetic and demographic connectivity between Sky Island black bear populations. Transportation and human settlement corridors have been found to be complicit in the demographic and genetic fragmentation of grizzly bear (*Ursus arctos*) populations in the northern Rockies (Proctor et al. 2005). However, to my knowledge, there has been no attempt to simultaneously quantify abundance and demographic and genetic connectivity for black bears. Black bears display limited sex-biased dispersal (i.e., females are highly philopatric whereas males typically disperse) and are sensitive to fragmentation effects that impede gene flow (Onorato et al. 2004) and, eventually, population abundance. Because of this, they should be highly susceptible to genetic and demographic fragmentation. To that end, my proposed research will provide AGFD Region 5 with important information in black bear abundance and sex ratios, while also advancing our understanding of the effects of natural and anthropogenic landscape fragmentation on large mammals in the arid southwest. The Sky Island region, where the maintenance of biological connectivity is critical, is an ideal location for this research approach. This work will provide important information on where black bear demographic and genetic connectivity is most vulnerable, thereby facilitating the identification of crucial linkage/corridor habitats. Additionally, the proposed research will compliment black bear genetic work conducted in Sonora, Mexico by University of Arizona, and hopefully provide information on trans-border genetic connectivity.

AGFD Research Branch received funding to initiate Phase I (2007; Huachuca and Patagonia mountains) of the research and is currently seeking additional funding to implement Phase II (2008; Santa Rita and Whetstone mountains). Numerous opportunities exist for additional funding- for example, World Wildlife Fund (WWF) has identified the Chihuahuan Desert as a priority conservation area due to unchecked development. A partnership between AGFD and other organizations (WWF and Wilburforce Foundation) is being pursued and would bring to bear substantial expertise and resources to begin addressing connectivity concerns in the Sky Island Ecosystem.

PROJECT OBJECTIVES:

- 1) Estimate the relative abundance and sex ratios of black bears in Region 5 GMU's 34 A & B.
- 2) Quantify the extent of genetic and demographic connectivity between black bears inhabiting Sky

Island mountain ranges in GMU's 34 A & B and 35 A & B.

- 3) Identify corridors facilitating black bear movement between adjacent Sky Island ranges.

PROJECT STRATEGIES:

I will sample bears using hair-traps consisting of single strand, barbed-wire corrals surrounding a scent lure (Woods et al. 1999). I will overlay $4 \times 4 \text{ km}^2$ grids on focal mountain ranges and hair-trap corrals will be randomly assigned to a grid cell. Hair-trap corrals will be checked every 14 days; a total of 4 capture/recapture sessions will occur from approximately 15 June 2008 through 15 August 2008. Hair will be removed from hair-trap corrals and total cell DNA from >2 hair follicles will be extracted and all samples will be initially genotyped at 6 microsatellite loci (Paetkau et al. 1998). Because individuals will likely be sampled multiple times, one sample from each individual will be sexed and genotyped further to 15 loci (Paetkau et al. 1998). To minimize genotyping errors I will use protocols detailed in Woods et al. (1999) and Paetkau (2003).

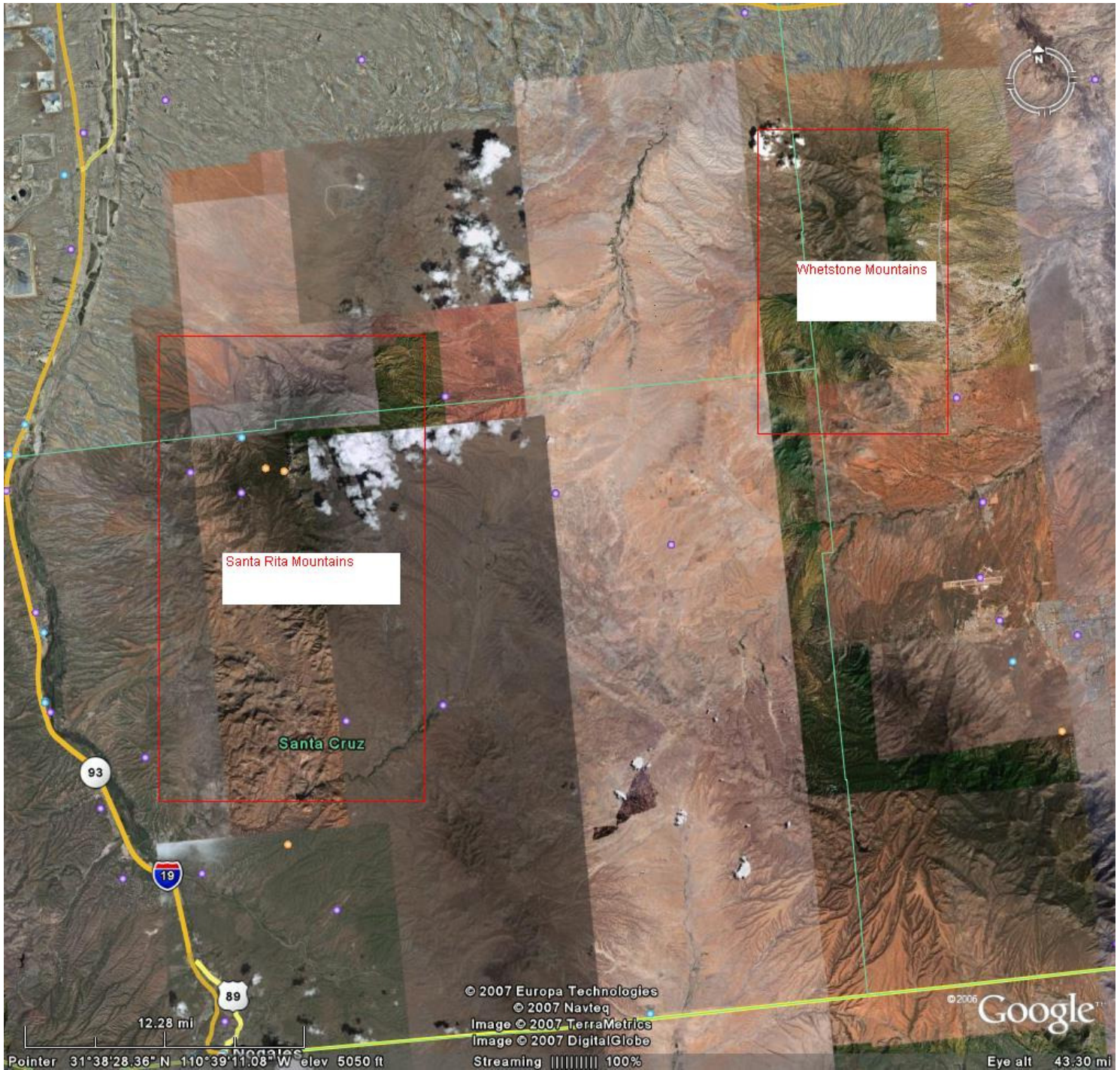
I will use program Capture to derive population density estimates. I will test for individual migrants across transportation and settlement corridors, and desert valleys using area-specific allele frequencies in a likelihood based assignment test (Paetkau et al. 1995) that calculates the probability of each individual's assignment to a particular area as the cumulative products of each allele's frequency of occurrence in any of several areas being examined. The individual is assigned to the area with the highest probability of occurrence. Additionally, I will run a confirmation test for migrants using a Monte Carlo Markov Chain algorithm in program STRUCTURE (Pritchard et al. 2000). STRUCTURE clusters individuals into groups through iterative assignments and develops probabilities of area origin for each individual through the cumulative results of those assignments. Individuals that repeatedly assign to a group other than that of their capture are considered putative migrants from their "source" area.

I will use genetic distances, D_{LR} (Paetkau et al. 1997) and F_{ST} (Weir and Cockerham 1984) to compare levels of genetic separation between sampling areas. Unbiased estimates of mean expected heterozygosity (H_e) will be calculated as an index of relative genetic variability (Nei and Roychoudury 1974). For the purposes of this study, I will define genetic fragmentation as when movement of both sexes between geographic areas has been limited and in extreme cases can result in an isolated population. Demographic fragmentation occurs when one sex's movement has been restricted.

PROJECT LOCATION:

The project will take place in Region 5 GMU's 34 A & B (Fig. 1), in the Santa Rita and Whetstone mountains (680 km^2) of the Coronado National Forest. The Santa Rita Mountains are centered at $31^\circ 38' 30.30'' \text{ N}$ and $110^\circ 52' 03.06'' \text{ N}$. The Whetstone Mountains are centered at $31^\circ 44' 53.00'' \text{ N}$ and $110^\circ 25' 09.32'' \text{ N}$.

Fig. 1. Santa Rita and Whetstone mountains.



LAND OWNERSHIP AT PROJECT SITE (Please state specifically if PRIVATE PROPERTY and provide landowner's name): US Forest Service, Coronado National Forest

IF PRIVATE PROPERTY, IS THERE A STEWARDSHIP AGREEMENT BETWEEN THE LANDOWNER AND THE DEPARTMENT?

NA

HABITAT DESCRIPTION:

The Santa Rita and Whetstone mountains range in elevation from 1500-3300m, and vegetation varies along

(revised 7-02-2007)

an altitudinal gradient. Low elevations are dominated by Sonoran desert scrub, transitioning to desert grasslands and oak (*Quercus spp.*) woodlands at mid-elevations. Upper elevations (>2000m) are dominated by ponderosa pine (*Pinus ponderosa*) and Engelman spruce (*Picea Englemannii*).

ITEMIZED USE OF FUNDS:

- hair snag bait and materials = \$1500
- genetic analyses 100 samples @ \$125/sample = \$12500
- ratio of match \$/grant \$ = 0.9/1.0

LIST COOPERATORS AND DESCRIBE POTENTIAL PARTICIPATION:

- 2 interns @ 40 hr/pay period @ \$9/hr = \$360/pay period for 6 pay periods = \$2160 (Int'l Bear Association- pending)
- intern per diem @ \$118/wk (4 days @ \$29.50/day) per intern = \$472/pay period for 6 pay periods = \$2832 (Int'l Bear Association, Pope and Young Club- pending)
- 800 miles per pay period @ \$0.50/mile = \$400 for 6 pay periods = \$2400 (AGFD, Research Branch- pending)
- Todd Atwood PS @ 20 hr/pay period @ \$23.21/hr = \$464.20 for 8 pay periods = \$3714 (AGFD, Research Branch- pending)
- Todd Atwood ERE @ 20 hr/pay period @ \$6.70/hr = \$134.00 for pay periods = \$1072 (AGFD, Research Branch- pending)

PROJECT MONITORING PLAN:

Hair-trap corrals will be constructed in April and may and sampling will begin in June. Hair-trap corrals will be sampled to 15 August, after which, hair-trap corrals will be removed. T. Atwood will monitor interns throughout the duration of the project.

PROJECT MAINTENANCE:

No maintenance will be required.

PROJECT COMPLETION REPORT TO BE FILED BY:

A completion report will be filed by T. Atwood by 15 December 2008.

WATER DEVELOPMENT PROJECTS (see attached worksheet):

NA

TREE SHEARING (AGRA-AXE, PUSH) PROJECTS (see attached worksheet):

NA